TEC DEVELOPMENT INTERNATIONAL
Memorandum

To: Kevin Adler

From: Chris French

Re: Your Questions Regarding Volatilization and Dilution in BSI Analysis

Date: March 3, 2004

The following information was provided to me by BSI, regarding your questions on volatilization and dilution in the BSI treatability analysis. Though I realize that you have in a tremendous amount of in-depth knowledge in the area of Bioremediation, I thought it would be prudent to relay to you as much of the information I received from BSI.

Technical Background

When analyzing for organic compounds the majority of analysis fall under three or four analytical methods.

These methods are:

- EPA SW-846 Method 8240 (Volatile Organics)
- EPA SW-846 Method 8260 (Semi-Volatile Organics)
- EPA SW-846 Method 8080 (Organo-chlorides)
- Other methods exist but these three are the ones that important.

8240 TESTS FOR VOLATILE ORGANICS

These are lighter molecular weight compounds, which typically have a higher vapor pressure and lower boiling point. Therefore they tend to volatilize easily. Examples of these types of compounds typically included your gasoline and diesel range organics such as Benzene, toluene xylene, etc. In general compounds with boiling points below 200 degrees are considered volatiles. The analytical test actually heats the sample and "strips" the volatilized compounds away from the sample for analysis.

8260 TESTS FOR SEMI-VOLATILE ORGANICS

These compounds typically have higher molecular weights, more complex chemical structures, lower vapor pressures and higher boiling point. The contaminants, PAH's, found at the GM site typically fall into this range. These samples cannot be stripped from the sample as described above. Solvents are used to extract these compounds from the sample before analysis.

8080 TESTS FOR ORGANO-CHLORIDES

These compounds typically include Pesticides, Herbicides and PCB's. These compounds have even higher molecular weights and boiling points along with more complex chemical structure and very low vapor pressure. These compounds also must be extracted using solvents. The boiling point of Aroclor 1248 is 340-375C.

BSI TESTING METHODOLOGY

- All sampling events were performed in triplicate to reduce "data scatter" or "outliers".
- Analysis was performed before and after the addition of ingredients/amendments.
- A negative control was maintained which received the same physical treatment and

maintenance as the compost tests without the addition of amendments or nutrients.
- One control test, and two composting tests, Ingredient A and Ingredient B were run.

VOLATILIZATION

The physically characteristics of PCB's and most PAH's are not conducive to volatilization. Volatilization can be a concern with some organics. Simply mixing contaminated soil can volatilize lightweight compounds such as benzene. Rather than actually treating the benzene it is simply emitted into the air. This is unlikely with most PAH's and certainly with PCB's. Additionally, the very nature of PCB's make them unlikely to be lost as a volatile.

During the bench test of the Waukegan Harbor PCB contaminated sediments and the Former GM Coke Plant PAH contaminated soils, a negative control was maintained in the exact same manner as the two compost studies, without the addition of organic amendments. This was done to ensure that any losses due to volatilization, or other factors, would be observed in the control.

In addition, as the lab reports indicate, the tests achieved temperatures just over 30 degrees C. Aroclor 1248 boils at 340-375C. Volatilization is highly unlikely at those conditions. Therefore, no air monitoring was performed.

In summary, BSI ran this negative control with both PAH and PCB studies. The negative control received the same mixing and maintenance activities the treatment cells received without the addition of organic amendments. Had the contaminants volatilized a reduction in concentration would have been observed in the negative controls as well.

Therefore, BSI assumes no measurable volatilization occurred during treatability testing of the Waukegan Harbor PCB contaminated sediments or the former GM Coke Plant PAH contaminated soils.

DILUTION

During the bench test of the Waukegan Harbor PCB contaminated sediments and the Former GM Coke Plant PAH contaminated soils, analytical samples were collected immediately before and after the addition of additives. Composting requires the addition of a significant percentage, typically 70% by volume, of organic materials. Some decrease in overall concentration is expected at this stage. The effect of this can be observed between original sample results for 17.12.2003 (Dec. 17, 2003) and Ingredient A and Ingredient B results for 19.12.2003 (Dec 19, 2003). Subsequent sampling events for Ingredient A and Ingredient B then demonstrated reductions in concentration over time with Ingredient A performing more along expected results.

With regard to Ingredient A, the amendment process is responsible for the change in concentration from 3.9 to 1.93. Biological degradation then takes it from 1.93 to 0.56. However, as time passes, the additives are degraded fairly quickly. So any "dilution" caused by the addition of organic nutrient will be lost as the organic amendments are degraded.

In summary, during the initial conditioning of the soils/sediments BSI added organic nutrients and chemical fertilizers. Some reduction in initial starting concentration was observed due to this added material. After that point, no other materials were added (except water to maintain moisture levels). After initial conditioning no dilution occurred.

Therefore, BSI assumes no measurable dilution occurred during treatability testing of the Waukegan Harbor PCB contaminated sediments or the Former GM Coke Plant PAH contaminated soils.

PCB BREAKDOWN PRODUCTS

In your last memorandum you inquired as to whether any analysis was performed to measure for PCB break down products, if any, from the bio process.

Analysis to measure for PCB break down products, if any, from the bio process were not performed.

However, we understand that the EPA might have has some methods under development for analyzing PCB breakdown products. If we might be of assistance, perhaps you could refer us to one of these methods and we might be able process a sample.

FORMER SLIP 3

In your last memorandum you mentioned that if the BSI process really involves biodegradation
of PCBs and not dilution and volatilization, then perhaps the process could be used to treat the soils within the former slip 3 containment cell. This process would be an innovative method, more highly favored by the Great Lakes Legacy Act.

As the above outlines, the BSI process biodegrades and does not volatilize or dilute the contaminated soils or sediments.

We would greatly welcome the opportunity to be considered by the Great Lakes National Program Office as the technology for the cleanup of the former slip 3 containment cell.

You also inquired as to whether the BSI process would work on 500 ppm PCB sediments. Though we are cautiously optimistic that the BSI process would be successful, it would of course require the rigorous testing that we have applied to date on the Waukegan Harbor PCB contaminated sediments and the Former GM Coke Plant PAH contaminated soils. It would be easy enough to accomplish this task once the treatment center is operational.

Kevin, as always we thank your for you interest and support.

Sincerely,

Christopher French
Managing Director
TEC Development International